

## Organic Food is Nutritionally Far Superior to Non-Organic Produce

A ground-breaking meta-analysis of 343 studies led by Newcastle University, U.K., has found that organic food delivers significantly more benefits compared to non-organic food. Among these are that organic food contains up to 69% more of key antioxidants and significantly lower concentrations of cadmium (50%), nitrates (30%), nitrites (87%) and pesticides. The frequency of occurrence of pesticide residues in conventionally grown crops was four times higher than in organic produce. This increased to seven times in the case of fruit. Antioxidants are linked to reduced risk of various diseases including cancer. Conversely, high nitrate and nitrite concentrations in food are considered as potential risk factors for illnesses such as stomach cancer. The researchers stress the urgent need for further studies specially designed to identify and quantify the health impacts of switching to organic food. The abstract of the study and a briefing note on it are reproduced below as Items 1 and 2.

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Item 1

### **Higher antioxidant concentrations, and less cadmium and pesticide residues, in organically grown crops: a systematic literature review and meta-analysis**

Baranski M et al. (2014) British Journal of Nutrition 06/2014;

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#### **Abstract**

Demand for organic foods is partially driven by consumer perceptions that they are more nutritious. However, scientific opinion is divided on whether there are significant nutritional differences between organic and non-organic foods, and two recent reviews concluded that there are no differences. Here we report results of meta-analyses based on 343 peer-reviewed publications that indicate statistically significant, meaningful differences in composition between organic and non-organic crops/crop based foods. Most importantly, concentrations of a range of antioxidants such as polyphenolics were found to be substantially higher in organic crops/crop based foods, with levels of phenolic acids, flavanones, stilbenes, flavones, flavonols and anthocyanines being an estimated 19 (95% CI 5, 33), 69 (95% CI 13, 125), 28 (95% CI 12, 44), 26 (95% CI 3, 48), 50 (95% CI 28, 72) and 51 (95% CI 17, 86) % higher respectively. Many of these compounds have been previously linked to reduced risk of chronic diseases, including cardiovascular and neurodegenerative diseases and certain cancers in dietary intervention and epidemiological studies. Additionally the frequency of occurrence of pesticide residues was 4 times higher in conventional crops, which also contained significantly higher concentrations of the toxic metal cadmium (Cd). Significant differences were also detected for some other (e.g. minerals and vitamins) compounds. There is evidence that higher antioxidant and lower Cd concentrations are linked to specific agronomic practices (e.g. non-use of mineral N and P fertilisers respectively) prescribed in organic farming systems. Overall it is concluded that on average, across regions and production seasons, organic crops have more antioxidants and less Cd and pesticide residues than the non-organic comparators.

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Item 2

## **NUTRITIONAL COMPOSITION OF ORGANIC CROP FOODS STUDY: BRIEFING NOTE**

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### **About the Study**

A new scientific paper published in the *British Journal of Nutrition* shows that there are significant composition differences between organic and conventional crops (primarily vegetables, fruit and cereals) that are relevant in terms of nutritional quality.

It is the most up-to-date analysis of the nutrient content in organic compared to conventionally produced foods, synthesising the results of many more studies than previous analyses. The findings are the result of a groundbreaking new systematic literature review and meta-analysis by an international team of scientists led by experts at Newcastle University.

The most striking differences revealed in the study are: higher concentrations of antioxidants, lower levels of cadmium, nitrate and nitrite, and less frequent presence of pesticide residues in organic crops compared with non-organic.

In presenting robust evidence of substantial differences and significant nutritional benefits from organic food, this study contrasts markedly with some previous studies, in particular with the findings of a 2009 UK Food Standards Agency (FSA)-commissioned study (Dangour *et al. Am. J. Clin Nutr.* 90, 680-685).

The new analysis of organic crops is based on 343 peer-reviewed publications solely focusing on organic crops, fruit and vegetables, whereas the FSA-commissioned study based its conclusions on just 46 publications covering crops, meat and dairy. The Newcastle University study specifically sought to identify and quantify compositional differences between organic and conventional crops (primarily cereals, vegetables and fruit) and crop-based products (e.g. seed oils, wine and baby food) based on a systematic review of all the available literature and data. With over 50% of the publications included in the new analysis published since 2006 (and therefore not available to the FSA-commissioned researchers, and other earlier studies), this review is a landmark in the advancement of our knowledge of the subject.

While people should not eat less fruit or vegetables, this study demonstrates that choosing food produced according to organic standards can lead to increased intake of antioxidants without increased calorie intake. With greater nutrient and antioxidant density, every mouthful of fruit and vegetables produced organically can count for more. This constitutes an important addition to the information currently available to consumers.

The authors of this study welcome the continued public and scientific debate on this important subject. The entire database generated and used for this analysis is freely available on the Newcastle University website (<http://research.ncl.ac.uk/nefg/QOF>) for the benefit of other experts and interested members of the public.

### **The Main Findings**

Organic crops/crop-based foods – on average, across regions and production seasons – have substantially more potentially health-promoting antioxidants, phenolics and (poly)phenolics and less potentially harmful cadmium, nitrite and pesticide residues than non-organic comparators.

The analysis indicates that the quality of food is strongly influenced by the way it is produced, and that organic farming methods lead to increased levels of nutritionally desirable compounds

and reduced concentrations of undesirable ones. In particular, there is increasing evidence that higher levels of manufactured chemical fertilisers, most notably the nitrogen and phosphate-based fertilisers that are prohibited or heavily restricted by organic farming standards, lead to substantially lower concentrations of antioxidants in conventional crops.

Organic farming prohibits the use of synthetic chemical pesticides, and promotes the use of balanced crop nutrition, crop rotation and mechanical, biological and cultural methods for weed, pest and disease control. This explained the very low incidence of pesticide contamination in organic compared to conventional crops found in the study and demonstrated that organic food consumption is an efficient way to reduce dietary pesticide exposure.

### **More Antioxidants/(Poly)phenolics**

Organic crops and crop-based food products were found to have significantly higher concentrations of antioxidants (including phenolic acids, flavanones, stilbenes, flavones, flavonols and anthocyanines) compared with their conventionally produced counterparts. The mean percentage difference for most antioxidant compounds was between plus 18% and 69%. Smaller, but still statistically significant, composition differences were also detected for a number of carotenoids and vitamins.

A switch to eating organic fruit, vegetable and cereals (and food made from them) would lead to a 20–40% (and for some compounds up to a 60%) increase in crop-based antioxidant/(poly)phenolic consumption without any increase in calories. This is important as there is strong scientific evidence of the health benefits of increased consumption of (poly)phenolics and other plant secondary metabolites with antioxidant activity, most notably protection against chronic diseases, including cardiovascular and neurodegenerative diseases and some cancers.

### **Less Toxic Metals and Nitrogen**

Substantially lower concentrations of a range of toxic heavy metals were detected in organic crops, particularly cadmium (on average 48% lower). Cadmium is one of only three toxic metal contaminants (along with lead and mercury) for which the European Commission has set maximum permitted contamination levels in food. Since it is known to accumulate in the body (especially the liver and kidneys), any reduction in cadmium consumption is positive.

Nitrogen concentrations were also found to be significantly lower in organic crops.

Concentrations of total nitrogen were 10%, nitrate 30% and nitrite 87% lower in organic compared with conventional crops.

The higher nitrate and nitrite concentrations in conventional crops are believed to be linked to the use of mineral nitrogen fertiliser, which is strictly banned under organic farming standards.

The significantly higher nitrite concentrations in conventional crops can be considered nutritionally undesirable, as they have been described as potential risk factors for stomach cancer and other conditions.

### **Less Pesticide Residues**

This study found that the frequency of occurrence of detectable pesticide is four times higher in conventional (46 (+/-4)%) than organic (11 (+/-2)%) crops.

Conventionally grown fruit had by far the highest frequency of pesticide residues (75 (+/-5)%), about seven times higher than in organic fruit. In conventional vegetables and crop-based

processed foods the frequency of pesticide residues was three to four times higher than in organic. All organic crop types were found to have similarly low contamination rates.

The understanding that they contain lower levels of pesticides is already a key factor motivating some consumers to choose organic foods, making this further information useful for consumer choice.

While further studies are needed to clarify the health benefits of reducing pesticide exposure, any reduction can be considered desirable, especially since we know that a significant proportion of conventional crop samples regulated by the European Food Safety Authority (EFSA) contain pesticide residues above permitted levels. For example, in recent EFSA surveys pesticide residues above the Maximum Residue Levels (MRL) were found in 6.2% of spinach, 3.8% of oats, 3.4% of peach, 3% of orange, 2.9% of strawberry and lettuce, 2.8% of table grape and 2.7% of apple samples.

The fact that pesticides are found twice as frequently in conventional fruit than in conventional vegetables is also significant and may point to greater use of persistent chemicals and/or pesticides being applied closer to harvest time in fruit crops.

### **Need for Further, and More Reliable, Scientific Studies**

This study identified serious deficiencies in a large proportion of previously published studies. These include a lack of standardised measurements and reporting, and evidence of duplicative or selective reporting of data collected in experiments.

The statistical methods used in the Newcastle University study were an advance over previous research syntheses that did not balance out the contribution of larger studies versus smaller ones. As well as having less evidence and not accounting for the amount of information, earlier syntheses used less reliable methodologies and inclusion criteria, and some included results from the same experiment multiple times.

The authors of the Newcastle University study also concluded that further research is needed to understand the variation between studies and that it is vital that future comparative food composition studies use standardised protocols.

This study identified significant differences, believed to be nutritionally beneficial, in the composition of organic compared with non-organic crops. However, it also highlights the need for more research to build our knowledge of the corresponding human health benefits of these differences.

The findings of this study clearly demonstrate the urgent need to carry out well-controlled human dietary intervention and cohort studies specifically designed to identify and quantify the health impacts of switching to organic food.

### **About the funding of this study**

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To read the full paper, as published in the *British Journal of Nutrition*, go to:  
<http://research.ncl.ac.uk/nefg/QOF>. This includes further information and annexes, and summary information in English, German, French, Italian, Greek, Polish, Czech and Finnish.

*Higher antioxidant concentrations, and less cadmium and pesticide residues, in organically grown crops: a systematic literature review and meta-analysis.* Leifert, C. *et al.* (2014) *British Journal of Nutrition* July 2014

The full dataset of this study is being made publicly available at  
<http://research.ncl.ac.uk/nefg/QOF>

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